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SYMPOSIUM ON ASTROPHYSICS

Special Committee on Cosmic Space
of the
National Science Conference of Japan

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TABLE OF CONTENTS

SYMPOSIUM ON ASTROPHYSICS

ABSTRACT

Opening Address

Takeshi Nagata

(University of Tokyo)

The development of astrophysics is due to:

(1) The development of atomic and nuclear physics which has clarified the physical properties of stars, space between stars, and circumterrestrial space;

(2) Direct observations of the space surrounding the Earth by means of rockets, artificial satellites, and spacecrafts;

(3) Observations from the ground stations whose equipment has been expanded extensively.

Five prominent speakers will discuss the future direction of our research on this subject.

Structure and Evolution of Stars and the Origin of Elements

Chushiro Obayashi

1. Introduction

The evolution of stars varies very much depending upon their masses. One of the conspicuous differences is the difference of electron degeneration. Another difference lies in the speed of star evolution.

2. Computation of Stellar Structure and Their Evolution

The structure of stars at certain instants is described by the fundamental equations on (1) the gravity balance, (2) the thermionic induction, and (3) the generation of energy.

The computation of stellar evolution depends upon (1) the loss and contraction of radiant energy and (2) the consumption of nuclear fuel.

3. Early Phase (up to H Burning)

In the early phase of the originating process of stars, condensation starts when the density of gas in space becomes larger than a certain point, and the contracting gravity force overcomes the thermionic movement, turbulence, and the pressure of the magnetic field. The thermionic property, which plays an important role in this case, is closely related to the abundance of H (atom) and H_2 (molecule).

4. Phase of Nuclear Burning

The stars of the main sequence occur in the state where H is burned as a major fuel (Figure 2). Then the shell-structure, shown in Figure 3, will be developed.

5. Final Phase

1. Stars of Smaller Mass

When the mass of an H-envelope of a large star is decreased to several %, the envelope is contracted, and the nuclear burning stops. Then it loses brightness and becomes a high density star.

2. Stars of Larger Mass

A large star will explode and blow away its gas, and becomes a high density star.

3. Comparison with Observations

1) Photometry

2) Spectroscopy

6. Quantity of Elements

The quantities of existing elements differ depending upon the location within the galactic system.

7. Formulation of Elements by Stars

CNO, MgSiS and Fe were formulated at the nuclear burning stage. As for the heavy elements, neutrons were generated at the He or C burning stages, and they were captured by Fe to form heavy elements.

8. Formulation of Elements at the Early Stage of the Universe

When the quantities of elements formulated in the galactic system are subtracted from those of existing elements, the remainder must be formulated at the early stage of the universe.

Particles and Magnetic Field in Space and the Evolution of the Galactic System

Yoichi Fujimoto

(Waseda University)

The historical background of the theory on the evolution of the galactic system, especially of the radio galactic system, is introduced.

Some considerations on galactic cosmic rays, as well as on extra-galactic cosmic rays, are illustrated.

The future plan of study along these lines is:

1) Study of aerial shower

2) Direct observation of composition of high-energy cosmic rays

3) High energy γ-rays.

4) X-rays

5) Wave propagation

6) Theory of evolution which combines the explosion of the galaxy with the dynamics of galactic evolution.

Solar Activity and Interplanetary Space

Tatuzo Obayashi

(Kyoto University)

1. Introduction

Interplanetary space is a wide area around the Sun covering 12 billion km. The most powerful space rocket reaches only the range of 50 million km, so that research must be conducted through astronomical or geophysical observations, and theoretical inferences.

2. Window to the Outer-atmosphere

The information from the outer-atmosphere reaches the Earth through the so-called windows to the outer-atmosphere. Modern astronomy looked at space through the window of light (3,000 - 7,000 Å). In addition, there are windows of electric waves (10 - 10,000 Mc/sec), of magnetic waves (below 100 kc/sec), and of high-energy particles (cosmic rays).

3. Solar Plasma

The Sun is the origin of various phenomena which can be observed in interplanetary space surrounding the Earth. Its energy radiation can be classified as electromagnetic waves, and fine-particle flow.

The electromagnetic radiation consists of thermionic radiation, electromagnetic waves (HF-UHF), and non-thermionic radiation in the X-γ-ray range. Besides this electromagnetic radiation, another large energy source is the solar plasma current reaching 1 - 10 ergs/cm,sec. It governs the phenomena in interplanetary space and the outer-atmosphere of the Earth.

4. Outer Magnetic Field of the Earth

The magnetic field of the Earth can be approximated by a dipole magnetic field centered at the Earth. This geomagnetic field is confined to a certain cavity by the interplanetary plasma.

5. Plasma in the Boundary Area of the Magnetic Sphere

6. Geomagnetic Tail

Various Problems of the Geomagnetic Sphere and Outer-Atmosphere

Nasohi Fukushima

(University of Tokyo)

1. Introduction

2. Distribution of Charged Particles and Their Movement in the Magnetosphere

The electron density of the F2 belt (300 km above the ground) is approximately $10^6/cm^3$. At 1200 km, there are $10^4/cm^3$ of charged particles (mainly electrons, hydrogen, helium and their ions). The Van Allen belt has a few high-energy particles (on the order of 8 Mev) per 1 m^3.

3. Atmosphere at High Altitude as the Medium of Electromagnetic Waves and the Magnetic Fluid

The atmosphere at high altitudes, as well as in the magnetosphere, is ionized and is subject to the geomagnetic field, so it exhibits a special property as a propagation medium of electromagnetic waves.

4. Current Flowing Through the Ionosphere and the Variation of the Geomagnetic Field

A wind of 100 m/sec in the ionosphere causes an electromotive force of VXB = 10^4 x 6.5 (emu). The origin of the current flowing through the ionosphere may be attributed to this electromotive force.

5. Atmospheric Light

6. Relation Between the Magnetosphere and the Lower Atmosphere

7. Complimentary Relation Between Observations by Rockets and Artificial Satellites, and Observations from the Ground

Structure of Planets and the Origin of the Planetary System

Shotaro Miyamoto

(Kyoto University)

1. Lunar Shell-crust

1) The lunar surface has dark areas called "seas" which are rather flat. The rest is covered by the so-called craters.

2) As for the origin of craters, two theories of meteorite origin and volcanic origin have been advocated.

3) To add to this argument on the origin of craters, three new aspects have been introduced in recent years. The first is the observation of a gaseous erruption from one of the lunar craters. The second is the theoretical computation of the internal temperature of the Moon. The third is the success of the close-up pictures of the lunar surface by the lunar rocket "Ranger".

2. Weather of Mars and Venus

3) Since the gravity of Mars is only 0.38 times the Earth's gravity, the Martian atmosphere is very thin.

6) Various weather phenomena, as well as their seasonal change, have been observed on Mars.

7) The circulation of the Martian atmosphere seems to be quite

different from that of the Earth.

8) A study of the Martian shell-crust has not been developed as yet.

9) As for Venus, there is not much information because it is covered by heavy clouds.

3. Meteorites and the Origin of the Solar System

10) A meteorite is considered to be similar to the original substance of the solar system.

11) Recent theories on the origin of the planetary system all assume a primitive solar nebula which surrounds the Sun. This is a revival of the old nebula theory of Kant.

Closing Speech

Yoshio Fujita

(University of Tokyo)

The absorption of light by the atmosphere cannot be neglected in the case of ground observations. It is well-known that the ratio of ^{12}C and ^{13}C plays an important role in the nuclear reactions of stars. However, the effect of H_2O must be eliminated in order to observe this phenomenon by means of the band-spectrum of CN (8,000 - 10,000 Å). Thus, observations from the outer-atmosphere will become more and more important, in addition to ground observations.